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Parasitic fish diseases and their impact on potential fish production in East Africa

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INTRODUCTION

Protein deficient diets are a standard way of life in many parts of East Africa; this of course tends to result in shorter life expectancy and chronic ill-health. Population increase is sufficiently high to outdistance the economic gains that may be made in various fields. With recurrent shortages of basic commodities not only in East Africa, but in many parts of the world, it is becoming increasingly clear that agricultural production practices must be maximised rapidly in order to meet the world's constantly expanding need for food. Here in East Africa, while our food requirements can be met most of the time, our protein requirements are far from being met. Yields from traditional fishery resources, must therefore be increased. The farming of fish (aquaculture) adds a new dimension to food production in general and high quality protein production in particular, in that it can be incorporated into other agricultural production activities.

An FAO report (PILLAY, 1972) records an annual aquaculture harvest of about one million tons from the estimated 500 million hectares of inland waters of the world. This does not include sport and some of the subsistance catches. The same source reports that production through aquaculture accounts for at least 40% of fish and shellfish produced in China and 38,22, and 20% of total fish harvest in India, Indonesia and the Philippines respectively.

The potential for aquaculture development appears to be considerable in most developing countries in general and in East Africa in particular.

For many years fishing in East Africa has been restricted to natural waters. The fishermen therefore depended on what nature could provide in terms of fish. No fisherman worried about management problems of the business, and much less so about the disease problems. Unfortunately we are witnessing a decline in fish catches over the past few years in almost all of our lakes in East Africa. We are therefore going to have to go into fish farming for two reasons: (a) to supplement the natural fisheries and (b) to do the business in a better managed and therefore more economical way. When this time comes, and I see no reason why it can't come very soon, we are going to have to very seriously consider both management and disease aspects of aquaculture.

Fish diseases can be divided into, viral, fungal, bacterial and parasitic diseases. This paper discusses parasitic diseases that occur in East African inland waters and hence are potential danger to our fishing industry. There are many diseases and these cannot all be covered in one paper of this kind; it is therefore considered prudent to discuss only those common diseases of fish.

Parasitic diseases can be grouped as those caused by protozoa, monogenean trematodes, digenean trematodes, cestodes, nematodes, acanthocephala and crustacea. OGAMBO-ONGOMA and CANARIS (1967) have shown some of the helminths of fish originally described in Africa.

ICHTHYOPHTHIRIASIS:

This is a protozoan disease of fish affecting both marine and freshwater fish in all parts of the world. It is caused by a holotrichous ciliate of the family Ophryoglaenidae called *Ichthyophythirius multifilis.* This ectoparasite parasitises the skin, fins, tails and gills of a variety of fish including trout, carp, tilapia and catfish.

Development of *Ichthyophthirius multifilis* has been studied by MACLENNAN (1935, 1937, 1945). The trophozoites are found in thin-walled cysts underneath the host's epidermis. They increase in size and divide to form 2 to 4 individuals. When trophozoites reach a certain size, they escape from their hosts and drop on to the bottom of the lake where the cysts are attached to the substratum by a specialised surface organelle.

Within the cyst wall the body cytoplasm fragments into 100 to 1,000 small spherical ciliated cells called TOMITES each measuring 18—22 microns in diameter. These tomites soon elongate to lengths of 40—100 microns. They eventually rapture out of the cyst wall and are then called THERONTS. The free-swimming theronts seek out new fish hosts and penetrate the epithelium.

Theronts can attack fish during the first 96 hours after excystment, but are most effective during the initial 48 hours. They die if they don't get a fish host. Once theronts encounter a host fish, they attach to the fish under the host's epidermis, and become TROPHOZOITES. Here the trophozoites actively ingest cell components and grow into large spherical opaque dark coloured granules. They form pustules on the fish's skin. These rapture and the ciliates are released in the water and so the cycle is repeated.

The disease is known to cause mass mortality in fish ponds. Epidemics of this disease have been reported in Russia and Southern United States of America. It occurs in East Africa although its impact has not been felt yet; this is simply so because we don't have commercial pond fisheries yet. The disease is a real potential danger in East Africa as we have very favourable climatic conditions for it.

DACTYLOGYROSIS:

This is a disease of fish caused by a monogenean trematode called *Dactylogyrus* which lives on the gill filaments of the host. They parasitize almost all freshwater fish, and are found in almost all parts of the world. There are many different species of *Dactylogyrus* however, all of them essentially cause the same disease.

Development of *Dactylogyrus* has been studied by LYAIMAN (1951), IZYUMOVA (1956), BAUER (1957, 1959), BYKHOVSKII (1957), and PAPERNA (1963). Adult trematodes lay eggs which are washed from the gills by the water and sink to the bottom of the lake. From these eggs hatch ciliated motile larvae. They attach to the gills, surface of the body and oral cavity, and begin to grow. They finally crawl to the gills from wherever they attached at first. Here on the gills they reach maturity and lay eggs which are washed into the water and thus the cycle is repeated.

Temperature is very important in the development of this trematode (PAPERNA, 1963). Thus the higher the temperature the shorter the time required to complete each life cycle and therefore the higher the trematode population. This parasite finds very favourable conditions in small, shallow warm water bodies.

This disease is known to cause mass mortality among smaller fish. Epizootics have been reported in Russia by MALEVITSKAYA (1952), IVASIK (1953), CHECHINA (1954), SMIRNOVA (1947) and AGAPOVA (1949). It occurs in most East African inland waters and is

therefore a potential danger to fish farming.

GYRODACTYLOSIS:

This is a fish disease caused by monogenean trematodes which belong to the genus *Gyrodactylus*. They parasitize on the surface of the body, gills and fins. Both marine and fresh water fish are parasitized. The distribution of this disease is worldwide.

Development of *Gyrodactylus elegans* was studied by KATHARINER (1904). Adult trematodes bring forth young larvae which then attach to the host and repeat the cycle.

This parasite is occasionally suspected of being detrimental to its host. YIN and SPROSTON (1948) reported death of fish due to gyrodactylosis. Death of these fish was attributed to the hypersecretion of mucous on the host's gill surfaces due to the irritation caused by the large number of parasites present. In addition, VANCLEAVE (1921) reported the death of bullheads, *Ameiurus melas* from gyrodactylosis. MASLENNIKOVA (1966) has reported that the intensity of infection increases with the density of the fish. The disease is especially dangerous to young fish, but adult fish seem to be healthy carriers.

Introduction of fertilizers in fish ponds has a favourable effect on the course of the disease. This may be due to the rich food supply, because the fish grow more rapidly and become resistant to the disease.

This disease occurs in most East African lakes and is therefore going to occur in man-made ponds. The disease, however, seems to be of minor importance although we need to be aware of it especially among young fish. Favourable climatic conditions such as those occuring in East Africa are particularly conducive to the rapid development of the parasite.

SANGUINICOLIASIS:

This is a fish disease caused by blood inhabiting digenetic trematodes of the genus *Sanguinicola*. The disease occurs in freshwater fish in all parts of the world.

Development of *Sanguinicola inermis* has been studied by SCHEURING (1920). The adult trematode is found in the blood vessels of the host fish. Eggs are discharged into the fish blood and are eventually located in the capillaries of the host's gills. In this location the eggs hatch and miracidia rapture through the gill tissues and escape into the water. Miracidia penetrate the snails of the genus *Lymnaea;* in the snail they develop and result in cercariae. The cercariae swim actively and penetrate fish through the gill filaments and finally reach the circulatory system where they mature.

Some species of *Sanguinicola* do not live in the host's blood vessels but are found in the heart, liver and other highly vascularised organs. *Sanguinicola* sp. found in East Africa parasitize a variety of fish including tilapia and the snail *Lymnaea natalensis* is the intermediate host. This author has found larval forms of *Sanguinicola* in Lakes Wamala, Victoria, George, Mulehe and Kioga.

This is a severe disease of very young fish, and must therefore be watched out for in fish ponds.

CLINOSTOMATOSIS: (Yellow Grubs)

This is a parasitic disease of fish caused by larvae (cercariae) of the digenetic trematodes which belong to the genus *Clinostomum*. Adults are found in the mouth of herons. The large metacercariae called yellow grubs are embedded subcutaneously or intramuscularly in a variety of fishes, black bass and tilapia included. In East Africa the disease is found in almost every lake.

Development of this trematode involves more than one host. Adult flukes

lay their eggs in the buccal cavities of herons; the eggs get into the water through two avenues: (a) They are washed into the water when herons dip their beaks into the water to catch fish, and (b) they are swallowed by the heron and are therefore voided with the faeces into the water. The eggs hatch and miracidia swim freely into the water.

Miracidia swim actively and penetrate snails of the family of Lymnaidae. Here in East Africa the specific snail host is *Lymnaea natalensis.* They develop in the snail and give rise to cercariae that escape from the snail and swim freely in the water. The brevifurcate cercariae upon contact with fish attach to the skin and burrow into the host. They encyst in the subcutaneous tissue and muscle and become metacercariae which are commonly called yellow grubs. When herons eat infected fish the metacercariae are released in the stomach from where they migrate anteriorly through the oesophagus into the buccal cavity. Here they mature and lay their eggs and thus the cycle is repeated.

DIPLOSTOMATOSIS:

This is disease of fish caused by cercariae of the digenetic trematode of the genus *Diplostomum.* The adult is found in the small intestines of ducks and gulls while the larval forms parasitize a variety of fish and lymnaeid snails. The distribution of this parasite is world-wide. It is a fatal disease of many freshwater fish.

Development of *Diplostomum baeri eucaliae* has been studied by HOFFMAN AND HUNDLEY (1957). This however, is only one of the many species of *Diplostomum.* The species that occur in East Africa use the local snails *Lymnae natalensis* as their first intermediate host. Adult trematodes lay their eggs and are passed out with duck faeces into the water where eggs hatch and ciliated miracidia escape into the water. In the water they penetrate *Lymnaea natalensis* and undergo development finally giving rise to cercariae. These cercariae emerge from snails, swim actively and penetrate the skin of the fish and get into the circulatory system. They are carried around and penetrate the optic lobes, optic nerves, cornea, retina, the gills or muscles and transform into metacercariae. The duck or gull gets infected when it feeds on infected fish.

This author has identified *Diplostomum* cercariae in snails from several lakes in East Africa, the parasite is therefore there and could prove very important in fishponds.

Warm temperatures encourage rapid development of this trematode. BAUER (1959) has reported that higher temperatures accelerate exit of the cercariae from the snail and increase their activity. Our climatic conditions in East Africa are just ideal for this parasite.

DIBOTHRIOCEPHALOSIS:

This is a disease of both fish and humans caused by the cestode commonly known as the broad fish tapeworm of humans, *Dibothriocephalus latus.* There are many other species that belong to the genus *Dibothriocephalus.* This cestode parasitizes a variety of freshwater fish including trout and perch. Its distribution is world wide. It has been reported in East Africa (HUDSON, 1934).

The adult cestodes live in the intestine of humans and other fish-eating mammals. Eggs are passed with faeces and end up in water where they develop. Ciliated larvae called Coracidium hatch and swim actively. They are ingested by crustacea of the genera *Cyclops* and *Diaptomus.* The coracidium then develops into a procercoid, which occupies the coelomic cavity of the crustacean host. When the infected crustacean is eaten by the fish, the coracidium is released in the fish intestine and becomes a procercoid. The procercoid migrates into the fish muscle and develops into plerocercoid which then

encysts. When a small fish harbouring plerocercoids is eaten by a bigger fish, the plerocercoids migrate and re-encyst in the muscle of the bigger fish. The mammalian host gets infected when they eat raw or poorly cooked infected fish. Plerocercoids thus released in the mammalian gut attach to the intestinal wall and develop into an adult and thus the cycle is repeated.

This disease carries extra importance due to its effect directly on the fish host and its role as a health hazard to humans.

LIGULOSIS:

This is a cosmopolitan disease of most zooplankton feeding fish. It is caused by a cestode called *Ligula intestinalis.* The disease is known to cause death among fish. MUSSELIUS (1966) has reported death of fish suffering from ligulosis in fish ponds in Russia.

Development of *Ligula intestinalis* has been described by DUBININA (1966) who showed that there are five developmental stages The adult cestode is found in the intestine of gulls, grebes, cormorants, pelicans and herons. Eggs are passed into the water with bird faeces. From the egg hatches a free-swimming coracidium which is swallowed by crustacea of the genera *Cyclops* and *Diaptomus.* In the crustacean, the coracidium develops to a procercoid which is the infective stage for the next host.

When fish eat infected crustaceans the procercoids are released in the fish gut from where they migrate into the muscle and become plerocercoids. When the avian host eats the infected fish, the plerocercoid is released in the bird intestine where it attaches to the intestinal wall and develops to adulthood.

This disease is very common in East Africa. This author has found it in both *Tilapia* sp. and *Micropterus salmoides* in most of the East African lakes.

CONTRACAECUMOSIS:

This is a fish and bird disease caused by nematode parasites of the genus *Contracaecum.* There are many different species of this parasite. The disease affects a variety of fish throughout the world. In East Africa the disease mainly affects various species of *Tilapia.* The disease has been found in most of the East African lakes by this author. Both fish and birds are known to die from the disease in East Africa.

Development of *Contracaecum* has been studied by HUIZINGA (1966, 1967), however the life cycle of the species we have in East Africa is still unknown. This author's suspicion is that we are dealing with a new species of *Contracaecum* that has not yet been described. Work on the life cycle and taxonomy of this species is well advanced and I hope that in the near future we shall know what species we are dealing with in East Africa and what its life cycle is.

The adult worms occur in the upper alimentary canal of cormorants and pelicans. In the pericadial cavity of *Tilapia* sp. is found the 3rd infective larva. Thus birds get infected by eating infected fish. Eggs are dropped in the water with bird faeces and develop. Eggs hatch and give rise to 1st stage larvae, larvae molt and become second stage larvae. The second stage larvae are ingested by the fish and migrate to the pericardial cavity and become third stage larvae which are infective. The 2nd stage larvae may also be eaten by a copepod and then the fish gets infected by eating infected copepod.

This is definitely a serious disease of fish. The worms are blood feeders and therefore take up a lot of blood from the fish host. Up to 200 worms have been recorded in *Tilapia leucosticta* from Naivasha. Pelicans and cormorants have been reported as dying from this disease in Lake Nakuru National Park. Dead or moribund birds were found to harbour lots of worms that seemed to have caused blockage of the upper portion of the alimentary canal.

ACANTHOCEPHALOSIS:

This is a disease of fish caused by spiny-headed worms of the phylum Acanthocephala. Several genera occur in East Africa. Unfortunately their taxonomy and life cycles have not yet been tackled in East Africa. They affect both *Tilapia* sp. and *Micropterus salmoides* in most East African lakes. They affect other freshwater fishes.

Their effect on fish is not yet well understood, however, they ruin the muscle of *Tilapia* sp. where they encyst.

Development of some of the known species of Acanthocephala is as follows: Adult worms occur in the intestine of piscivorous fish such as *Micropterus salmoides*. Eggs are passed out into water with fish faeces. Crustacea of the order Ostracoda ingest the eggs and they hatch in the ostracod gut resulting in acanthors which migrate to the coelom of the host. On reaching the coelom they elongate and become acanthellas. Smaller fish feeding on zooplankton become infected by eating infected ostracod. The acanthellas are released in the fish gut, they migrate and get into the liver and form cysts. Some will migrate into other fish muscles and become encysted. The final host gets infected by eating a smaller infected fish.

ERGASILOSIS

This is a disease of fish caused by crustacea of the genus *Ergasilus* which parasitize on the gills of fish. It is of cosmopolitan distribution, and affects many different fishes.

Development of *Ergasilus* has been studied by NEUHAUS (1929), HALISCH (1939) and GNADENBERG (1949). The mature female has two egg sacks. These eggs hatch into nauplii (larvae) which swim freely in the water and undergo molting. There are four nauplii and four copepodid stages each preceded by a molt. Differentiation of the sexes and copulation take place during the 4th copepodid stage. The males die after copulation while females enter the branchial cavity and reach the gill rakers and finally the gill filaments. They attach to the gills using their antennae although they are able to move.

Ergasilus feeds on the tissue of gills and on blood.

The disease occurs in East Africa among the Nile perch and could affect other fishes. This disease could be of importance in fish ponds.

This has been a survey of the most common parasitic diseases of fish found in East Africa. It is by no means exhaustive; there is no doubt that there are other diseases that have not yet been encountered but may be here with us. There are very numerous parasites of fish that are of no major consequences; these have been deliberately left out of this paper.

There are two major aspects of the effect of parasitic diseases to any fishing industry. 1. The direct effect of the disease to the fish leading to low yields by some fish dying, others not reaching maximum weight for their age because of the detrimental effect of the disease, and by discarding some of the parasitised fish. Thus although for example a fish suffering from contracaecumosis is just as palatable to eat, no housewife wants a "wormy" fish at her table. It is a matter of aesthetics more than anything else. Contracaecumosis doesn't affect humans and those worms are just another source of proteins! It is however, regretable that because of aethetics they can't be eaten! 2. The second aspect of parasitic diseases of fish is that of public health consideration. Dibothriocephalosis for instance is one of the fish diseases that affect humans. So that apart from decreasing fish yields, the disease affects humans too.

From the foregoing account, it is evident that the fishing industry in East Africa will have to address itself to the

problem of fish diseases, if this industry must be developed to its maximum potential.

LITERATURE CITED

Agapova, A.I. 1948.
A study of Parasitic Diseases of Young Fish in the Alma-Ata Nursery. *Izvestiya AN KazSSR. Seriya ParazitologicheskiKh Nauk. No. 6.* (Original paper in Russian).

Bauer, O.N. 1957.
Diseases of Carp in Pond Farms in the Leningrad, Velikie Luki and Novgorod Regions. *Izvestiya VNIORKh, Vol. 42* (Original paper in Russian).

Bauer, O.N. 1959.
Ecology of Parasites of Freshwater Fishes. *Izvestiya GosNIORKh, Vol. 49.* (Original paper in Russian).

Bykhovskii, B.E. 1957.
Monogenetic trematodes, their Systematics and Phylogeny. *Izdatel'stvo AN sssR.* (Original text in Russian).

Chechina, A.S. 1954.
Diseases of fish in Belorussia after the War. *Trudy Problemnykh Soveshchanii Zin, No. 4.* (Original paper in Russian).

Dubinina, M.N. 1966.
Ligulidae (Cestoda) of the USSR. Moskva-Leningrad, Izdatel'stvo "Nauka". (Original text in Russian).

Gnadenberg, W. 1949.
Beitrage zur Biologie und Entwicklung des *Ergasilus sieboldi* Nordmann. *Z. Parasit., Vol. 14.*

Halisch, W. 1939.
Anatomie and Biologie von *Ergasilus minor* Halisch, *Z. Parasit., Vol. II.*

Hoffman, G.L. and J. B. Hundley, 1957.
J. Parasit., 43:613.

Hudson, J.H. 1934.
A list of Cestodes known to occur in East African mammals, birds and reptiles. *J. East Africa and Uganda Nat. Hist. Soc., 49—50: 205—217.*

Huizinga, H.W. 1966.
Studies on the life cycle and development of *Contracaecum spiculigerum* from marine piscivorous birds. *J. Elisha Mitchell Sci. Soc., 82: 181—196.*

Huizinga, H.W. 1967.
The life cycle of *Contracaecum multipapillatum. J. Parasit., 53: 368—375.*

Ivasik, V.M. 1953.
Parasites of Carp on Fish Farms in the Western Ukraine and the Diseases caused by them. *Trudy Nauchno-Issledovatel'skogo Instituta Ozernogo i Rechnogo Rybnogo Khozyaistva, Vol. 8. Kiev.* Original paper in Russian).

Izyumova, N.A. 1956.
Data on the Biology of *Dactylogyrus vastator* Nybelin. *Parazitologicheskii Sbornik ZIN AN SSSR, Vol. 16,* (Original paper in Russian).

Kathariner, L. 1904.
Ueber die Entwicklung von *Gyrodactylus elegans. V. Nrdm. Zool. Jahrb., 70: 519—550.*

Lyaiman, E.M. 1951.
Effect of the water temperature on the reproduction of *Dactylogyrus vastator. Trudy Mosrybvtuza, No. 4* (Original paper in Russian).

MacLennan, R.F. 1935a.
Observations on the life history of *Ichthyophthirius,* a ciliate parasitic on fish. *Northwest Sci., 9:12—14.*

MacLennan, R.F. 1935b.
Dedifferentiation and redifferentiatio.. in *Ichthyophthirius* I. Neuromotor system. *Arch. Protistenk., 86: 191—210.*

MacLennan, R.F. 1937.
Growth in the ciliate *Ichthyophthirius.* I. Maturity and encystment. *J. Exper. Zool., 76: 423—440.*

MacLennan, R.F. 1942.
Growth in the ciliate *Ichthyophthirius.* 2. Volume. *J. Exper. Zool., 91: 1—13.*

Malevitskaya, M.A. 1952.
Parasitic Diseases of young Carp in Fish Farms in the Eastern Ukraine. *Trudy VNIIPORKh UKrSSR, No. 7.* (Original paper in Russian).

Maslennikova, E.I. 1966.
Gyrodactylosis of Carp. Author's Summary of Candidate Thesis. Kishinev (Original work in Russian).

Musselius, V.A. 1966.
Digrammosis of Bighead. *Materialy nauchnoi Konferentsii VOG, Part I.* (Original paper in Russian).

Neuhaus, E. 1929.
Untersuchungen uber die Lebensweise von *Ergasilus sieboldi. Z. Fisch., Vol. 27.*

Ogambo-Ongoma, A.H. and A.G. Canaris, 1967.
A guide to Helminth species described from African Vertebrates. 207p. West Virginia University Library, Morgantown, W. Va. U.S.A.

Paperna, J. 1963.
Some observations on the Biology and Ecology of *Dactylogyrus vastator* in Israel. *Bamidgeh, Vol. 15, No. 1.*

Pillay, T.V.R. 1972.
The role of aquaculture in fishery development and management. Technical conference on Fishery Development and Management, Vancouver, Canada, 24p. Mimeographed.

Scheuring, L. 1920.
Die Lebensgeschichte eines Karpfenparasiten *(Sanguinicola inermis* Plehn). *Allg. Fisch. Ztg., 45: 225—230.*

Smirnova, K.V. (1947).
Parasitology of fish in the Alma-Ata Carp Nursery. *Uchenye Zapiski Ural'skogo Gosudarstvenogo Pedagogicheskogo Instituta im. Pushkina, No. 1* (Original paper in Russian).

VanCleave, H.J. (1921).
Notes on two genera of ectoparasitic

trematodes from freshwater fishes. *J. Parasit., 3: 33—39.*

Yin, W.Y. and N.G. Sproston (1949). *Studies on the monogenetic trematodes of China., Parts 1—5. Sinesia, 19: 57—85.*